Improved methodology for High fidelity simulations and model tests of novel floaters for FOWT

Publieke samenvatting / Public summary

Motivation and background

In the latest market projections from the Carbon Trust, they forecast 70GW of floating wind capacity installed by 2040. Offshore floating wind (OFW) is emerging as a very promising renewable energy sector.

Pilot and demonstration projects have shown the potential for similar, or even higher yields from floating turbines compared to bottom-fixed offshore wind turbines, as they can be situated in locations with stronger wind resources. Carbon Trust have identified several challenges in technology development that need to be addressed in order to enable commercially viable floating wind farms . Simulations and model tests have an important role in maturing the technology. MARIN is one of the leading testing centres for new floating wind concepts. As wind turbines grow in size it becomes more challenging to perform accurate and realistic model tests. . In addition to horizontal access wind turbines, new concepts such as high-altitude airborne wind energy concept, and vertical axis wind turbines. Previously, demonstrator (pilot) projects were a popular way to gain experience in the technology. However, we have noticed that clients are moving away from such projects, due to the high cost and the relatively low impact on the technology. The floating wind market is becoming similar to the oil and gas market segment, in that it

Projectinformatie / Project information

Projectnummer / Project number
TKITOE_WOZ_2008_MARIN_IMPROVED_FOWT
Subsidiebedrag / Grant amount
€ 100.000,00

Algemene informatie / General information

Penvoerder / Secretariat
MARIN

Publicaties en materialen / Publications and attachments

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now requires an extensive set of numerical simulations to be validated using high quality model tests before construction and deployment offshore can begin. This requires both simulations and model tests to be as representative as possible of the full scale system.

MARIN and GustoMSC formed a partnership (PPS) to develop this methodology for FOWT. TKI Wind op Zee partly funded the PPS research project.

Objective

The aim of the project is to develop an improved methodology for simulating and model testing floaters for floating wind turbines. The proposed approach will be robust and flexible and will allow for different concepts to be tested.

Methodology

The research consisted of three successive work packages:

WP 1 , fundamental research and development was undertaken to develop and extent the numerical platform aNySIM XMF with an aerodynamic model for simulating a wind turbine. The aerodynamic loading functionality has been added to the framework by means of the BEM (Blade Element Momentum) Theory library.

In WP 2 the developed framework used to run hydrodynamic simulations for floating wind turbines and used during model tests by means of the SIL approach. The SIL was used for testing the floater developed in the Horizon 2020 EU project FLOTANT as shown below in figure.

In WP 3 GustoMSC has tested the improved aNySIM XMF tool, including the new functionalities added within the framework of the project, such as the blade element momentum (BEM) module. GustoMSC modelled its proprietary FOWT design, the Tri-Floater, equipped with a reference wind turbine in the new aNySIM XMF tool and performed simulations to verify the performance of the model. The results have been compared to existing coupled

aero-servo-hydro-elastic coupled simulations.
During steady state tests, the model performs well.

Results and Summary

The results of the project resulted in a methodology which consist of one numerical frame work for simulating floating wind turbines both numerically and through the SIL setup during model tests. This results in more accurate modelling of floating wind turbines in-line with the future technical requirements for the development of commercially viable floating offshore wind farms.

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